Space Weather Technical Forecast

Issued on Friday, 25 August 2023 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-flares throughout (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with a peak flare of M1.4 at 25/0109 UTC from AR3415 in the southeast. There are six sunspot region on the disc. AR3415 (Dac/Beta-Delta) remains the most complex and active region with two moderately strong umbra spots sharing the same small penumbra. This region continues to provide a risk of significant flares, especially if any additional development occurs. AR3413 (Dhi/Beta) in the northeast quadrant is the largest region, containing a small trailer spot to the north of its main, large dominant leader. There is also occasional proliferation of spots within the intermediate portion of the group. The region maintains some potential instability due to its east-west aligned neutral polarity line. AR3405 (Cso/Beta) in the northwest continues to see some minor proliferation of opposite polarity spots with isolated low-level C-flare activity. The other spots were also smaller, mature, unipolar spots, including a new, as yet unnumbered region recently rotated over the southeast horizon.

No definitive Earth-directed CMEs have been observed, although a couple of potential candidates are still to be assessed. The C4.1 flare of AR3405 at 25/2214 UTC had an associated coronal dimming event to the east of its position. A faint CME has been detected in LASCO imagery, moving mainly to the west and will be analysed for any potential Earth-directed trajectory. A CME was observed from the previous LP C3.0 flare at 24/2033 UTC, however this was from over the northwest limb. The long-duration event from the M1.4 flare of AR3415 at 25/0109 UTC also resulted in a weak CME signature in LASCO and STEREO A imagery, but appears to be mainly, or exclusively behind Earth.

Solar Wind / Geomagnetic Activity: A transition into the fast wind of CH39/+ was observed during the first half of the period, followed by the gradual transition out of the same fast wind in the second half of the period. Solar wind speeds increased from 360-400 km/s (background) to become more persistently slightly elevated from around 24/1500 UTC. Briefly elevated speeds were observed with a peak of 520km/s at 24/1841 UTC, but remained more generally 440-500km/s for a period, before declining from around 24/2300 UTC, easing to 380-400km/s (background to slightly elevated) by the middle of the UTC day on 25 Aug. Density was largely average to begin with, but has gradually declined to become below average. The interplanetary magnetic field (IMF) Bt, was weak initially but briefly rose to Moderate, peaking 9nT around 24/1600 UTC, before declining to persist around 4-6nT between 24/1630 UTC and 25/0030 UTC, after which very low values of 1-4nT have been observed. The north-south component has been mainly negative (southward) with only brief periods of positive (northward) direction. Peak values of +7/-7nT were recorded. The Phi angle was initially negative (towards the Sun) but rotated to be positive (away from the Sun) from 24/1700 UTC. A period of mainly negative phi angle was observed between 25/0200-0600 UTC, before becoming largely positive again. Resultant Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background. GOES16 high energy (greater than 2MeV) electron flux was Background to Moderate, peaking 600 pfu at 24/1535 UTC. The associated 24-hour fluence was

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well below the Active level, with a generally flat trend and an observed value of 1.03e7 integrated pfu at 25/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is expected to be generally Low, but with a chance of isolated M-class flares; this most likely from AR3415.

Solar Wind / Geomagnetic Activity: No definitive Earth-directed CMEs have been observed, although a couple of potential candidates are still to be assessed. Ongoing, but weakening fast wind influence from CH39/- at first with winds around 380-400km/s. This continuing to ease day 1 and 2 (25-26 Aug) with a further enhancement then possible from central disc CH38/- or northern disc CH37/-, either late day 2 or day 3 (26-27 Aug). Quiet with isolated Unsettled intervals at first. The arrival of any CIR and associated fast wind of CH38/- and/or CH37/- late day 2 or day 3 (26-27 Aug) is then forecast to increase activity to Unsettled with Active intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background levels. High energy (greater than 2 MeV) electron flux is expected to rise in response to the recent fast wind enhancement, to more persistently Moderate and perhaps peaking at High day 2 (26 Aug). Any further fast wind arrival either late day 2 or day 3 (26-27 Aug) will then likely drop out observed flux again. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

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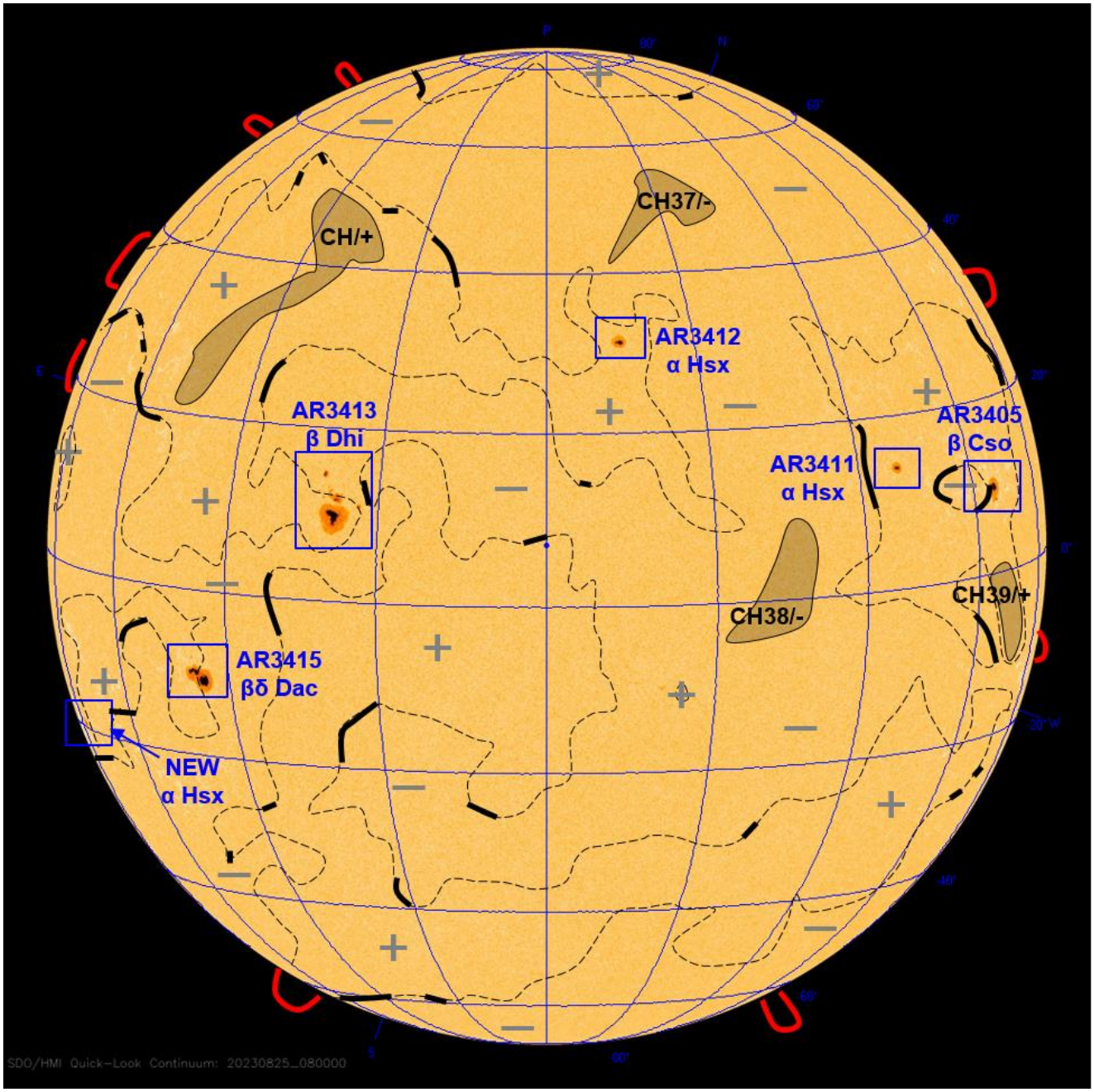
Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No definitive Earth-directed CMEs have been observed, although a couple of potential candidates are still to be assessed as indicated in the 'Analysis of Space Weather activity over the past 24 hours' section.

Earth transitioned into the late arriving, and slightly weaker than originally anticipated fast wind of CH39/+ on 24 Aug, with solar winds peaking around 520km/s (elevated), since then speeds have reduced to 380-400km/s (background to slightly elevated) and are expected to ease further in the coming 24 hours. A further enhancement is then anticipated on either late day 2 or day 3 (26-27 Aug), due to the arrival of the next fast wind, most likely from CH38/- in the centre disc, but perhaps northern disc CH37/-. Solar winds then easing again day 4 (28 Aug).

27-day persistence provides little guidance for expected arrival times of CH38/- and/or CH37/-, and Enlil has a poor representation of current conditions reducing confidence in the model forecast. However, this does suggest an enhancement around 26-27 Aug, with the later arrival currently preferred. Any connection to this hole is also likely to be limited due to its negative polarity and the Russel-Mcpherron effect.

Quiet with isolated Unsettled geomagnetic activity is forecast at first. The arrival of any CIR and associated fast wind of CH38/- and/or CH37/- late day 2 or day 3 (26-27 Aug) is then forecast to increase activity to mainly Unsettled with Active intervals. Given the low confidence and unfavoured coronal hole polarity, there is only a very slight chance of G1 Minor Storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

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Radio Blackouts - X-Ray Flares:

Low activity is expected to continue, but with a chance of rising to Moderate due to a risk of isolated M-flares throughout. A very isolated X-flare cannot be completely ruled out.

There are currently six sunspot regions on the disc, with AR3415 in the southeast currently the most active with an M1.4 flare observed at 25/0109 UTC. It is a moderately large region with two opposite polarity and moderately strong umbra sharing a single small penumbral area. Any development or destabilisation of this region has the potential to generate a reasonable M, or perhaps low X-flare. AR3413 is the largest spot on the disc, and with an east-west polarity separation line, also has the potential for notable flare activity. However, this region has been largely inactive in the past 24 hours despite the occasional proliferation of spots within the intermediate portion of the group. AR3405 in the northwest is due to rotate over the western horizon in the next couple of days. Although this appears to be a simple bipolar group, it does have a preceding plage area with a nearby filament. Additionally SDO imagery perhaps suggests some more complex magnetic looping that is potentially obscured due to it now approaching the northwest limb. Overall, this remains a small spot however and unlikely to produce significant flares. A new unnumbered region recently rotated over the southeast horizon. Tentatively this is given an Hsx/Alpha classification, but could be revised should it reveal further spots as it rotates into clearer view. The other two regions remain small mature unipolar spots.

Coronagraph imagery suggests that a region, either linked to the new southeast limb sunspot, or new sunspot group is due to imminently rotate over the eastern solar horizon. Notable magnetic looping infers that this region could be significant region and will be monitored closely.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	35	35	35	35
Very Active	R3 to R5 X Class	No	5	5	5	5

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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background. The main risk of any increased proton flux would be from the occurrence of any larger flares of AR3415, currently in the eastern hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux observed by GOES16 is currently Background to Moderate, but expected to rise in response to the recent fast wind enhancement of CH39/+, perhaps more persistently Moderate later day 1 (25 Aug) and with a chance of peaking at High day 2 (26 Aug). A further fast wind enhancement either late day 2 or day 3 (27 Aug) from CH38/- or CH37/- will then likely lead to flux dropping out to background. The connection to this feature is expected to be more limited than the current fast wind, with flux potentially only recovering to Moderate later day 4 (28 Aug).

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, but rising in response to the recent solar wind enhancement, before declining again later day 3 (27 Aug) onward due to any further HSS enhancement. REFM is likely to be poor guidance currently, as it has yet to account for the recent solar wind increase.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	10	10	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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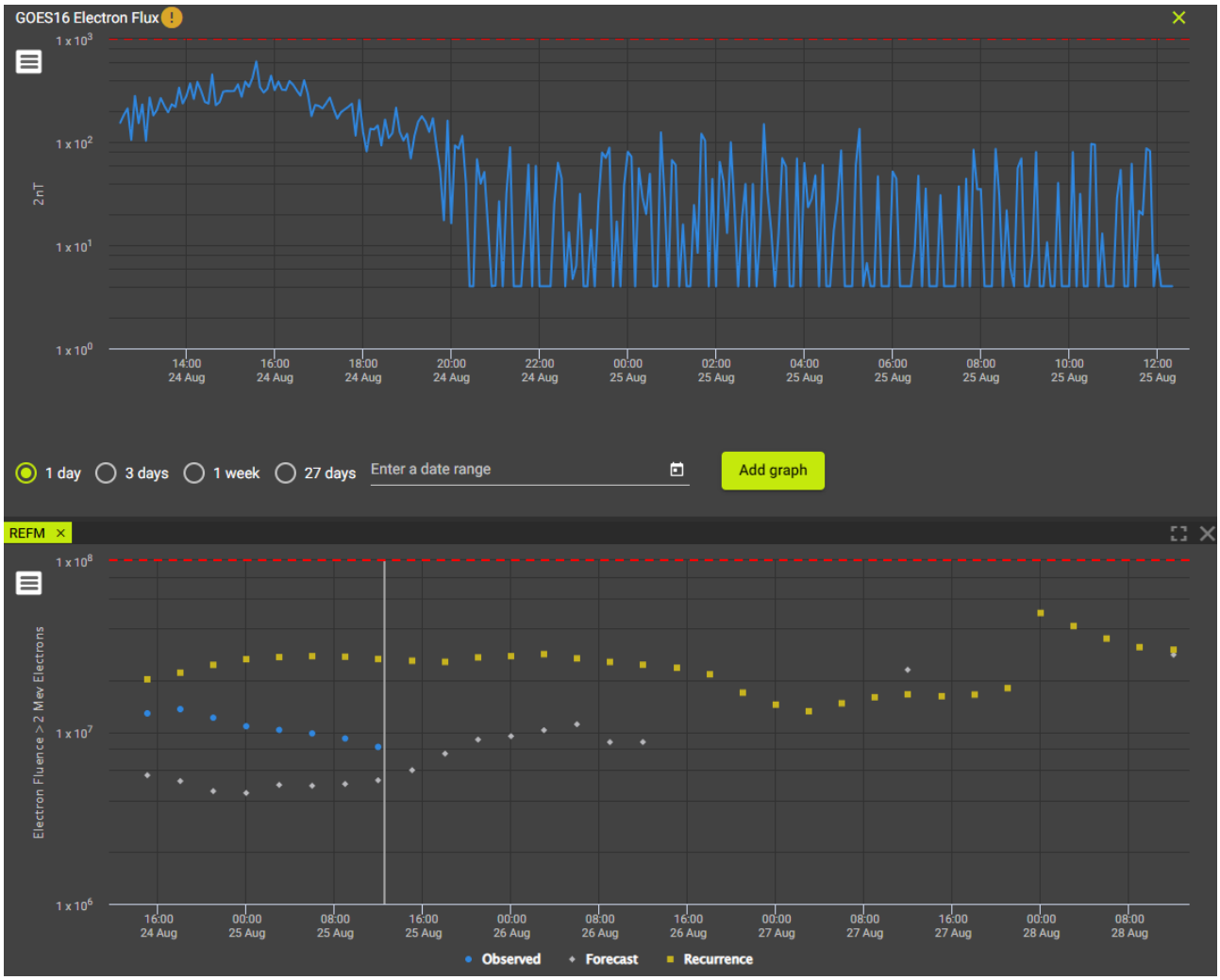
Figure 2: GOES16 >2MeV Electron Flux (above) and associated fluence with REFM (below)



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